Gymnastics Band

The present invention relates to an exercise band (gymnastics band) made of a flexible, elastic material for strengthening musculature, ligaments and tendons of the locomotor system, which is used especially in medical treatment.

Conventional exercise bands are made of rubber (natural rubber) or latex. Latex is associated with a number of disadvantages, however. For example, it is known that many people experience an allergic reaction to latex, which can result, for example, in local skin irritation, such as eczema, when latex-containing exercise bands are used. Furthermore, latex tends to have a tacky consistency and is therefore often dusted with powder or the like in order to prevent the exercise band from sticking to itself. The application of powder to latex gives cause for considerable concern on health grounds, however, because the powder itself can act as an allergy-triggering substance on the skin. In addition, the powder easily passes into the air when the exercise band is being used and can be inhaled, often loaded with latex particles, and enter the user's lungs, so that powder and/or latex in the lungs are able to trigger systemic allergic reactions. A further disadvantage of latex is that many people find its odour unpleasant.

When being extended or stretched, latex is also distinguished by non-linear force-displacement characteristics which, as is known to medical therapists, result in a solely auxotonic load on the musculature, that is to say as the amount by which the exercise band is stretched increases the tensile resistance with which the exercise band opposes

being stretched rises super-proportionally. That is not always desirable, however, because, as a result, the range of movement of joint parts when the exercise band is stretched can be severely limited if the strength of the muscles is insufficient to stretch the exercise band sufficiently.

In order to ensure a sufficient range of movement in the case of weaker muscles, it is therefore necessary to select an exercise band having a relatively low tensile resistance, which, if the material remains the same, has hitherto been achieved solely by varying the thickness of the exercise band or by modifying the Shore hardness of the rubber-like material. Conversely, an exercise band having a tensile resistance that is too low for a specific muscle can readily develop small cracks, which can result in sudden and abrupt tearing of the exercise band, which in turn can lead to injury.

The aim of the present invention is to provide an exercise band with which the disadvantages mentioned at the beginning can be avoided.

That aim is achieved according to the invention by the features of claims 1, 2 or 4. Advantageous configurations of the invention are given in the subsidiary claims.

The present invention relates to an exercise band for strengthening musculature, ligaments and tendons of the locomotor system, which is made of a flexible, elastic band material. The exercise band comprises at least one thermoplastic (preferably at room temperature), elastomeric

material (a) and a further material (b) that is different from the thermoplastic elastomer.

The material (b) especially comprises silicone or Teflon.

Preferably the materials (a) and (b) are present in different layers.

It is further preferred that at least one layer comprises silicone or Teflon and another layer of the thermoplastic elastomer different from silicone or Teflon.

Alternatively or in addition, the exercise band comprises at least one thermoplastic elastomeric material and has on at least one side (that is to say on one side or on both sides) depressions in the form of channels along the longitudinal direction (lengthwise relative to the direction of stretching) of the band.

According to the invention, the exercise band is made of a band material which comprises at least one elastic - preferably at room temperature (that is to say at, for example, about 21°C) - thermoplastics material or thermoplastic elastomer, referred to hereinbelow as a thermoplastic elastomer or thermoplastic elastomeric material.

Examples of thermoplastic elastomers are, for example, styrene block copolymers (TPE-S), SEBS, thermoplastic copolyesters, polyether esters (TPE-E), thermoplastic polyurethanes (TPE-U), polyether-polyamide block copolymers (TPE-A). Such thermoplastic elastomers are thermoplastic and elastic *per se*, that is to say also without addition of further materials.

Thermoplastics materials have, in principle, lower elasticity than elastomers. According to the invention, however, it is also possible to use thermoplastics materials that are provided with elastic properties by addition of appropriate materials known *per se*, such as, for example, fillers and/or plasticisers. The thermoplastic elastomers used according to the invention can generally be combined with fillers and/or plasticisers such as, for example, waxes, Aerosil (highly disperse silicic acid), colourings, glidants (oleic acid amide, erucamide), anti-oxidants (hydroquinones, pyrocatechols, gallates etc.) or barium sulfate.

The use of a thermoplastic elastomer advantageously makes it possible to dispense with the use of allergy-triggering latex or the powders applied thereto. Since thermoplastic elastomers do not age as quickly as latex, the additional advantage is obtained that the exercise band has a considerably reduced risk of tearing in the event of overstretching, so that injuries can be avoided.

According to the invention, the thermoplastic elastomers can be mixed with other, especially elastic, materials (preferably with crosslinked materials). Preferred here are, for example, addition-crosslinked or condensation-crosslinked silicones (especially silicones addition-crosslinked under platinum catalysis), EADM rubber, NBR rubber and other irreversibly crosslinkable materials.

In a further advantageous embodiment of the invention, the exercise band has a layered structure and has at least two layers of different materials. When the exercise band has such a layered structure, the stretching properties or

tensile resistance of the exercise band can be influenced in the desired manner in an especially simple way by the selection of suitable layer materials. It is also possible thereby to improve the chemical resistance of the thermoplastic elastomeric materials with respect to oils and solvents (such as are present, for example, in nail varnish removers or disinfectants) and also to stabilise them with respect to elevated temperatures. Especially advantageous is a layer of at least one thermoplastic elastomer that is combined, for example, with a layer of Teflon or a layer of silicone and/or mixtures thereof. Preferably, the thermoplastic elastomer is coated on both surfaces with a layer of a different material (especially silicone or Teflon). It is also possible for one side of the band to be coated with one material, for example silicone, and the other side of the band with a further material, for example Teflon. Special preference is given to the thermoplastic elastomer being completely covered or encapsulated by a layer of a different material (preferably silicone and/or Teflon). This can be effected, for example, by coating in a dipping bath or during extrusion. By means of such a coating, the chemical resistance and thus the durability of the band material is improved. The band can accordingly also be more easily disinfected in order to avoid the risk of contact infection of users.

The layer comprising a thermoplastic elastomer preferably has a layer thickness of from 50 μm to 2 mm, especially from 100 μm to 1 mm, more especially from 200 μm to 600 μm. The further layer(s) can have a thickness of from 5 μm to 2 mm; if the layer containing the thermoplastic elastomer is coated with Teflon, the Teflon layer preferably has a thickness of from 10 μm to 15 μm. When the band comprises a first

layer containing a thermoplastic elastomer and a second layer containing silicone, the layer thickness of the second layer is preferably from 5 to 100 % of the layer thickness of the first layer.

It is also preferable for the exercise band of the present invention to have on one or both sides an absorbent surface which is especially in the form of a flock coating having absorbent fibres or in the form of an applied fleece. Examples of absorbent fibres are cellulose, synthetic fibres and viscose. The absorbent surface can be produced, for example, by electrostatic flock coating or by pressing a fleece onto the hot thermoplastic elastomer (for example after extrusion). Preferably the absorbent surface is not applied to the thermoplastic elastomer using an adhesive.

The band material can comprise only one thermoplastic elastomer or a mixture of thermoplastic elastomers.

In accordance with a preferred embodiment, the exercise band of the present invention comprises in one layer a mixture of at least one thermoplastic elastomer (a) and a material (b) that is different from a thermoplastic elastomer, preference being given to a ratio by weight (a) : (b) of from 30:70 to 95:5 % by weight, especially from 85:15 to 95:5 % by weight.

Examples of the mentioned materials which are different from thermoplastics material are: silicone (especially addition-crosslinked or condensation-crosslinked silicones), Teflon, acrylonitrile-butadiene rubber (NBR), EPDM rubber (for example Santoprene), polyurethanes, polystyrenes and other irreversibly crosslinkable materials that form a three-dimensional structure. The term silicone denotes, for

example, higher molecular weight compounds having a three-dimensional framework composed alternately of silicon and oxygen atoms. Silicon atoms in silicones that do not achieve their electron octet by the formation of bonds to oxygen are saturated with organic radicals R. The framework can be linear or highly branched. An example are polymeric compounds composed of repeating units of the general formula R_2SiO, the radicals R being the same or different and being customary radicals known to the person skilled in the art. Examples of radicals R are hydrogen, methyl, vinyl or phenyl groups.

By means of the channels present in a preferred embodiment it is possible, by virtue of the associated "weakening" of the band material, for the tensile resistance of the exercise band on stretching to be reduced selectively in an extremely advantageous manner. In other words, by virtue of the surface structuring, specific desirable force-displacement characteristics can be imparted to the exercise band on stretching. For example, the surface structuring can impart linear force-displacement characteristics to the exercise band.

The channels, which are preferably provided, also bring about a reduction in the contact surface area of the surface plane of the exercise band. Because thermoplastic elastomers can also have tacky properties, the channels can advantageously also prevent the exercise band from sticking to itself by reducing the surface plane having the tacky effect.

Furthermore, at a force that is comparable in relation to a plain band, raised longitudinal structures between the

channels prevent sudden (abrupt) tearing of the band and therefore provide a considerable contribution to the protection of the user/patient.

In a preferred embodiment, at least one of the two surfaces of the band has a plurality (at least 2) of depressions (channels) which, starting from the surface plane of one side, extend in the direction of the remote side. Such depressions can have, in each case perpendicular to the surface plane, a rectangular, especially square, or round cross-section. The depressions (channels) advantageously extend along the direction of stretching of the band.

In accordance with a further embodiment, the exercise band can have a honeycomb-like surface structure. Such a structure imparts to the band similar properties to those of a woven material, that is to say a high degree of flexibility and a low tendency to bulge or form folds, combined with a high resistance to tearing. This is brought about by the "ridges" remaining between the honeycombs of an exercise band so constructed. The ridges advantageously extend at right-angles to one another, so that the depressions in the surface plane have a rectangular, especially square, cross-section. This imparts a substantially uniformly characteristic stretching behaviour to the band. Alternatively, the depressions can each have in the surface plane a hexagonal, especially a regular hexagonal, cross-section.

The two surfaces or the surface structures of the exercise band according to the invention can be identical or different.

The depressions can, for example, be produced by stamping of the finished exercise band. Alternatively, it is also possible, for example, to provide the depressions as early as at the stage of manufacturing the exercise band, for example by means of suitable raised portions during moulding or extrusion.

In accordance with a further preferred embodiment, the exercise band according to the invention comprises at least one longitudinal reinforcement strip of a material different from the band material in order further to reduce the risk of sudden tearing. Such a reinforcement strip, which is preferably tear-resistant, can have, for example, a length corresponding to the length of the band when stretched by the maximum extent; it can be arranged in or on the band in a zig-zag shape or in loops, for example.

It is also preferable for the exercise band of the present invention to comprise an indicator that displays the level of force applied. The indicator can be, for example, a colour indicator or a strain gauge, such as is used in scales. The indicator can consist of a piezoelectric material. The use of such an indicator advantageously enables the force applied to be monitored and therefore allows regulated treatment.

The exercise band according to the invention can be produced by melting and subsequent solidification, as is customary also in the case of conventional latex exercise bands. It is preferable according to the invention, however, for the exercise band to be produced by extrusion, which is considerably more economical. For that purpose, the band material should preferably be an extrudable material.

In a preferred configuration of the invention, a band material is used which, on being stretched in the band direction, exhibits substantially linear force-displacement characteristics even without the use of additives. That is to say, when the exercise band is stretched the tensile resistance increases substantially in proportion to the stretching of the exercise band; preferably, therefore, the band substantially complies with Hooke's Law. A band material having such behaviour can be used in an especially advantageous way for strengthening muscles, ligaments and tendons of the locomotor system: as already mentioned above, in contrast to conventional exercise bands it allows a greater range of movement of joint parts, so that, in particular, the mobility of joints under load can be trained. In addition, because the increase in the tensile resistance as the exercise band is stretched is smaller than in the case of conventional exercise bands, the risk of unintentional overloading of the locomotor system of the user is avoided, for example where tendons are weak or have been previously injured, such as, for example, after rupture of a tendon. As a result, not only can renewed damage to the tendon, for example as a result of microscopic cracks that would otherwise occur, be avoided, but also the progress of a treatment can be beneficially influenced.

In accordance with a further advantageous embodiment, the ends of the exercise band according to the invention can be in the form of loops, which can be produced, for example, by fusing to itself. Alternatively, the ends of the band can be joined to one another (for example by fusing together the ends) in order to obtain an endless loop. If desired, the exercise band can be provided with grips at the ends.

As has been explained, the exercise band according to the invention has excellent properties in respect of resistance to tearing and stretching behaviour. In addition, the exercise band can be manufactured economically by means of extrusion.

The invention will now be described with the aid of exemplary embodiments, reference being made to Fig. 1.

Fig. 1 shows a diagrammatic view in cross-section in the band direction of an exemplary embodiment of the exercise band according to the invention.

Fig. 1 shows a portion of an exercise band according to the invention in a cross-section in the band direction, the section being made perpendicular to the plane of the band. The exercise band 1 is made of the thermoplastic elastomer TPE-S and produced by extrusion. Both surfaces of the exercise band are provided with a surface structure. The surfaces have a plurality of depressions 4 which, starting from the surface planes 2, 3 of the two sides, extend in the direction of the remote side. The depressions 4 are channel-like in shape, the channels extending along the band direction of the exercise band 1. By means of the channels 4, the raised areas 5 adjacent to the channels 4 are formed. The surface structures of the two sides of the exercise band have been produced by stamping of the exercise band which has been produced by extrusion. By means of the surface structure in channel form, selective weakening of the tensile resistance of the exercise band 1 on stretching can be achieved.